Quantitative Tools for Health Impact Assessment of Land Use and Transportation Systems

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A Health Impact Assessment Toolbox Includes

- Guidance for the HIA Process and Public Participation
- Screening and Scoping checklists
- Existing conditions indicators and data
- Qualitative Research Methods
- Quantitative Assessment Tools
- Communication and ReportingTools

Quantitative Tools: Assessing Environmental Conditions and Forecasting Health Effects

- Mapping Existing Environmental Data
- Health Risk Assessment
- Spatial Regression Models
- Spatial Health Conditions Metrics

Spatial Variation in Air Pollution

Measures From Short Term Sampling

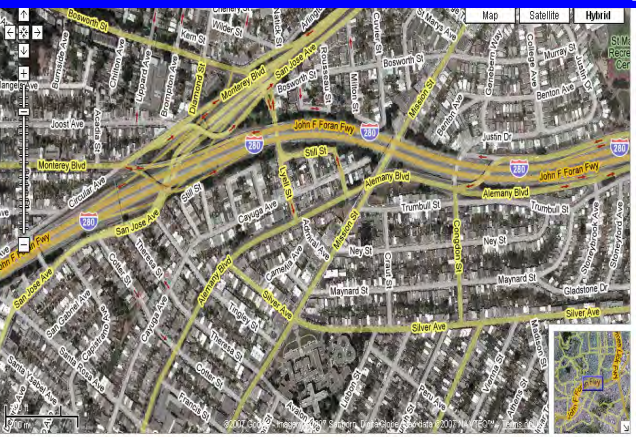
Eastern Waterfront San Francisco

Blue Greenway Bike Tour Air Samples

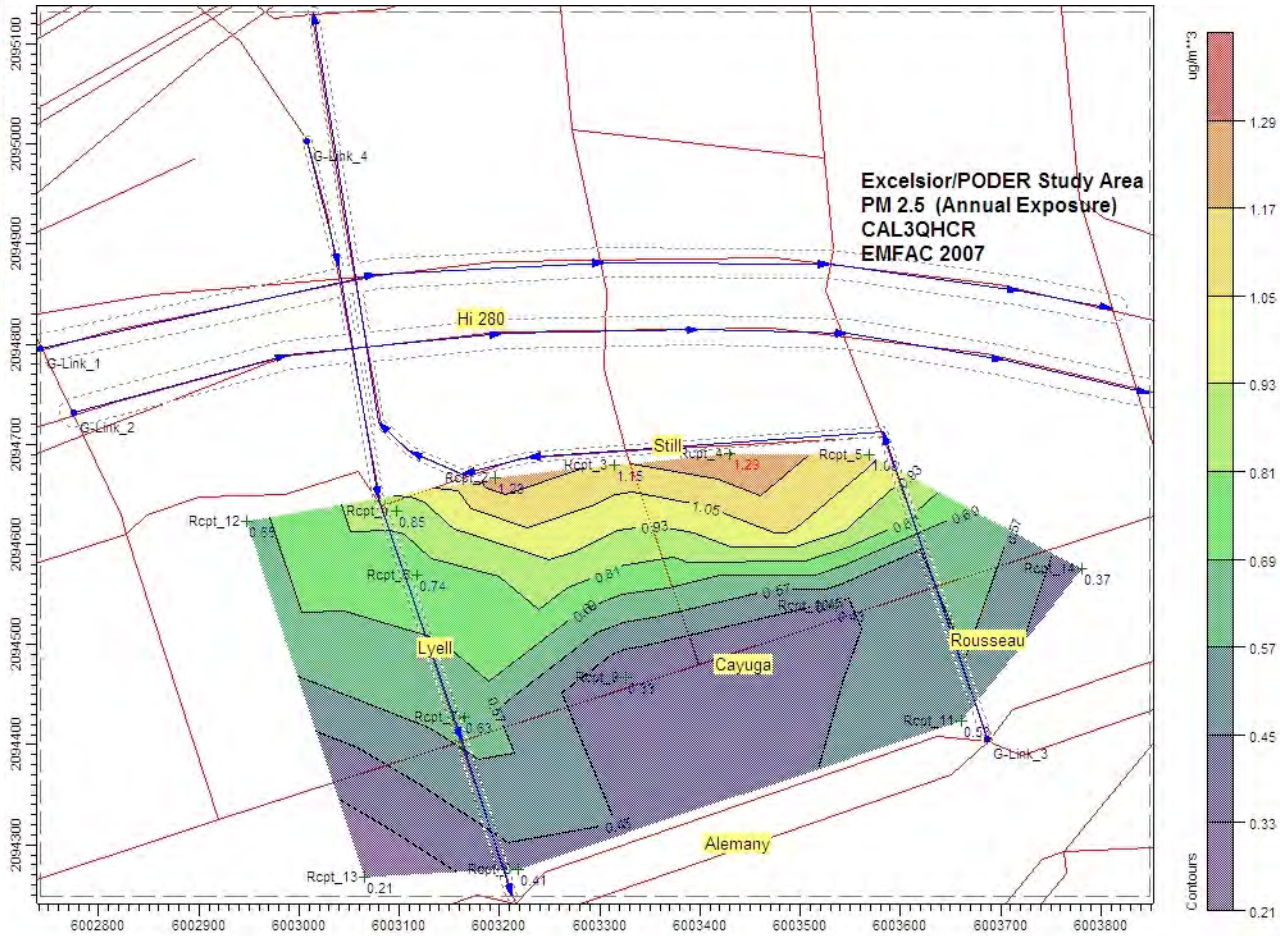
Health Risk Assessment
Applications to Transportation Systems

- Health Effects are Functions of:
  - Environmental Exposure
  - Concentration-response relationships;
  - Population at risk
  - Population Sensitivities
- Transportation-related “Exposures” are Functions of
  - Vehicle Flow, Speed
  - Emissions
  - Relationship between Facilities and Sensitive Receptors

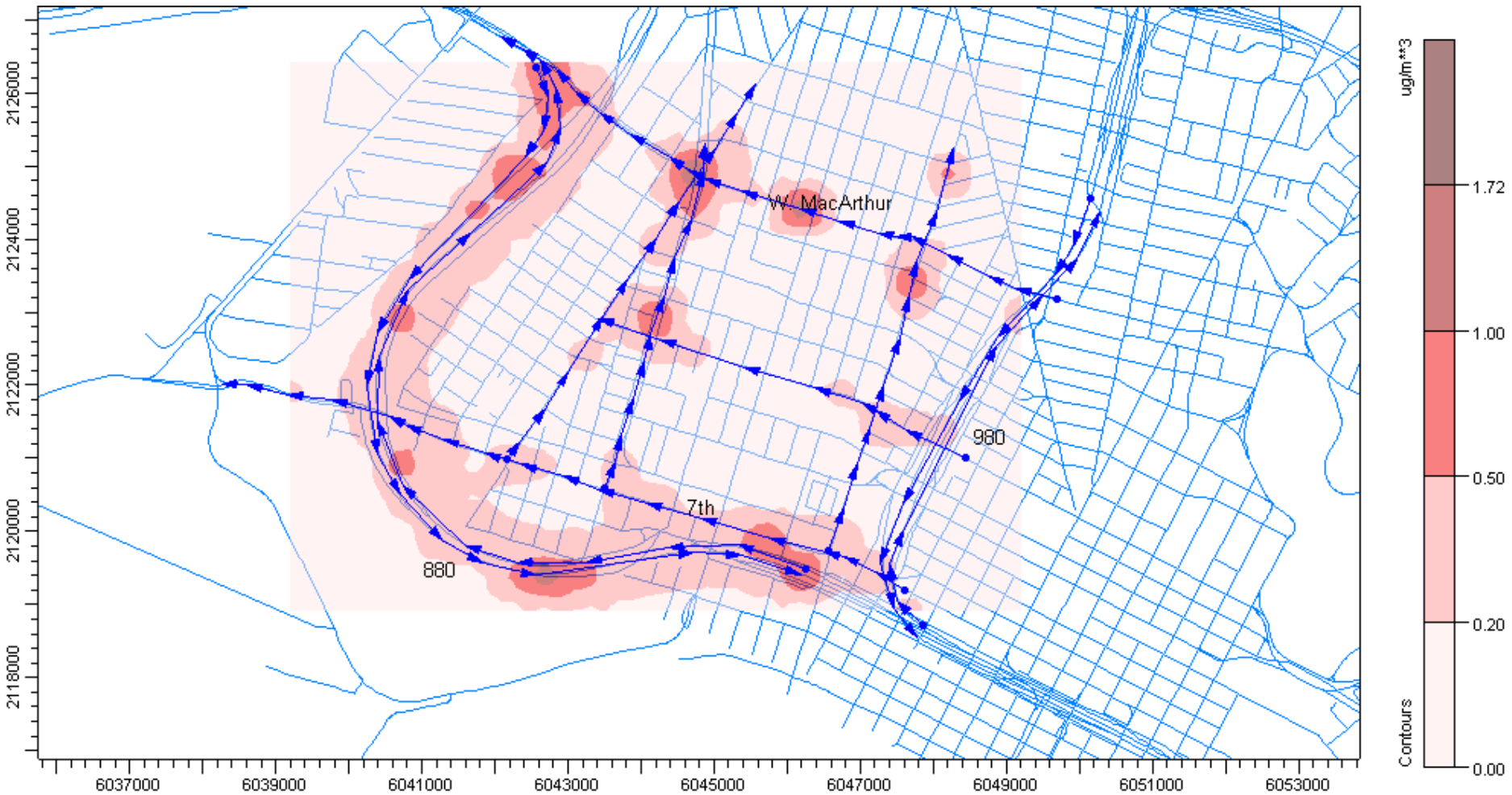
Spatial Extent of Vehicle Source $PM_{2.5}$ CAL3QHCR Line Source Dispersion Model Excelsior District, San Francisco, CA



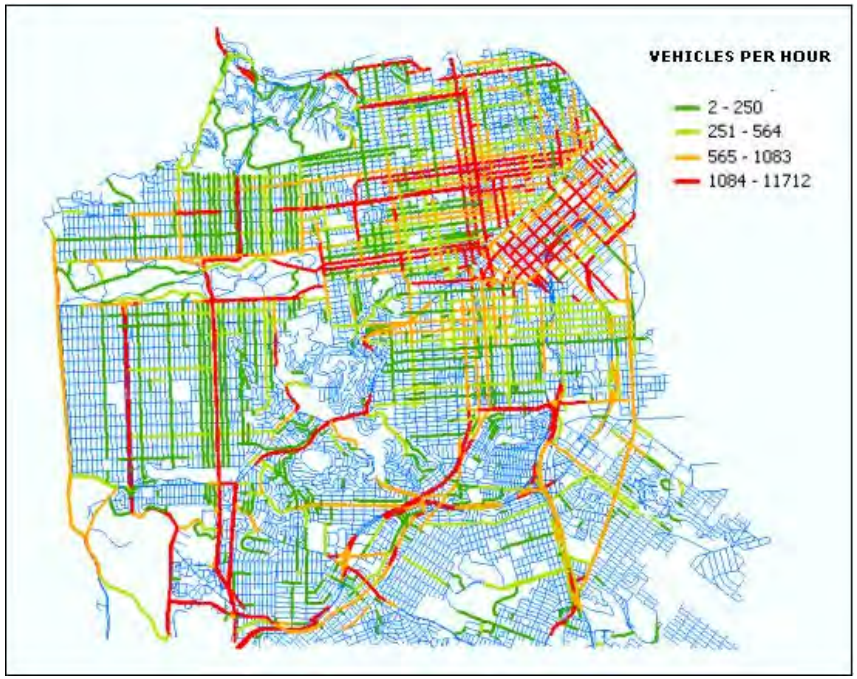
A 1 ug/m³ change in $PM_{2.5}$ predicts a 1.4% change in non-injury mortality!

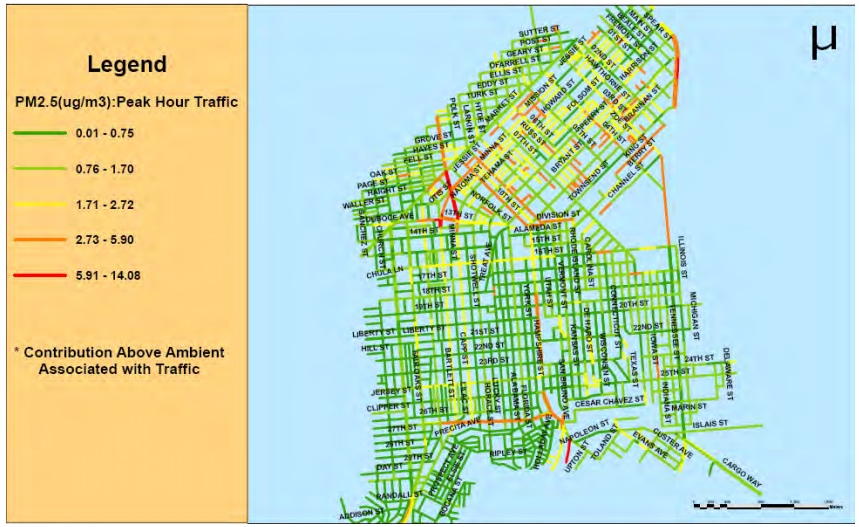


Modeled Spatial Extent of Vehicle $PM_{2.5}$ All Vehicle Sources—West Oakland, CA



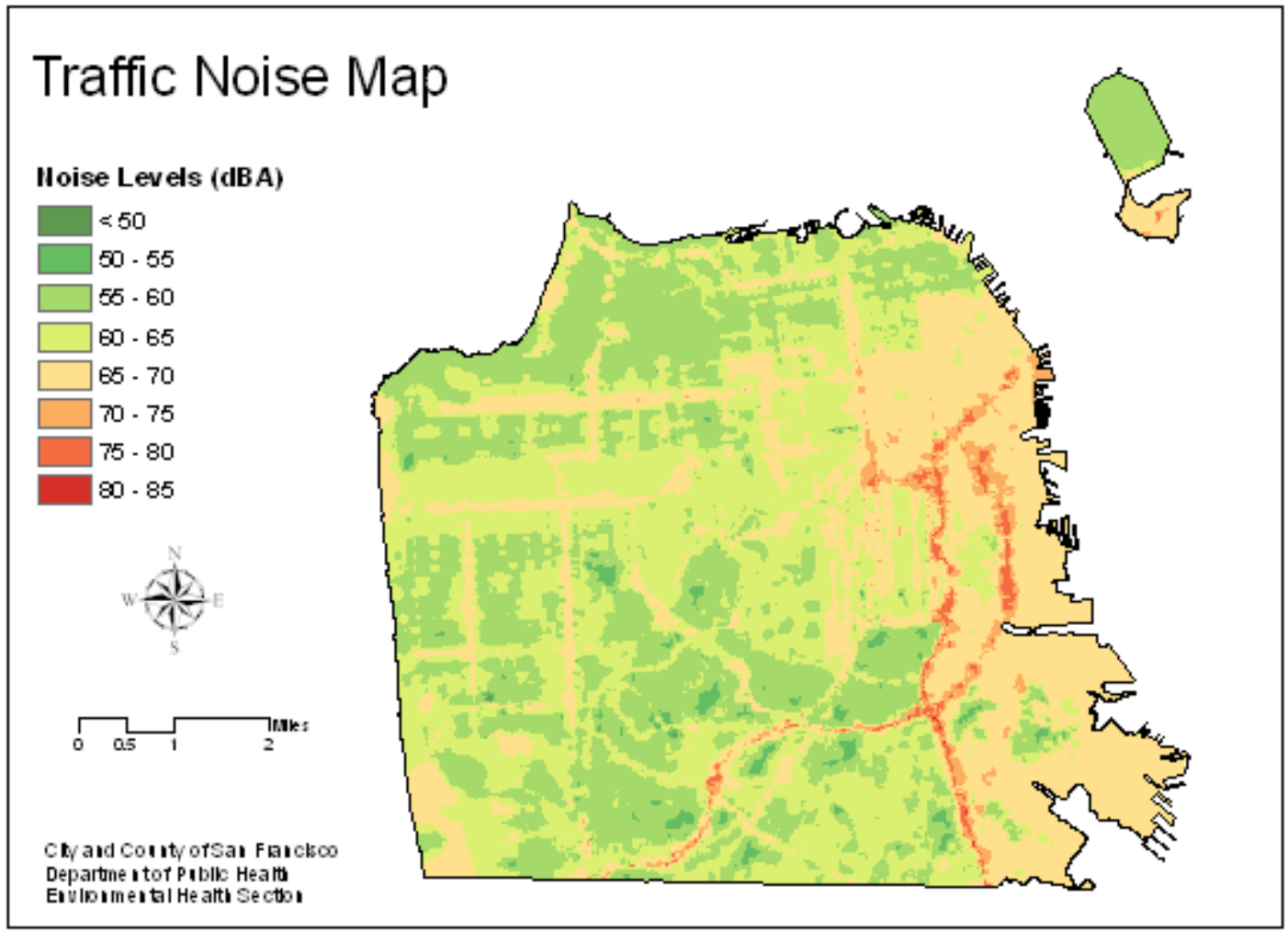
Modeled Vehicle Source Pollutant Concentrations Southeastern Streets—San Francisco, CA





Spatial Extent of Vehicle Traffic Noise All Vehicle Sources—San Francisco, CA

The exposure threshold for increased incidence of heart disease is 55 dBA at nighttime!



Spatial Regression Models
Applications to Transportation Systems

- **Dependent Variable:** Health Status Outcome aggregated at the area-level or Health-related Environmental Condition
- **Independent Variables:** Social and Environmental Conditions measured at the area-level
- **Multivariate Regression Model:** relates environmental conditions to health status
- **Applications:** Changes in Environmental Conditions predict changes in Health Outcome or Environment (under assumptions); Use in Impact Assessment of Policies or Plans

SF Pedestrian Vehicle Collision Model

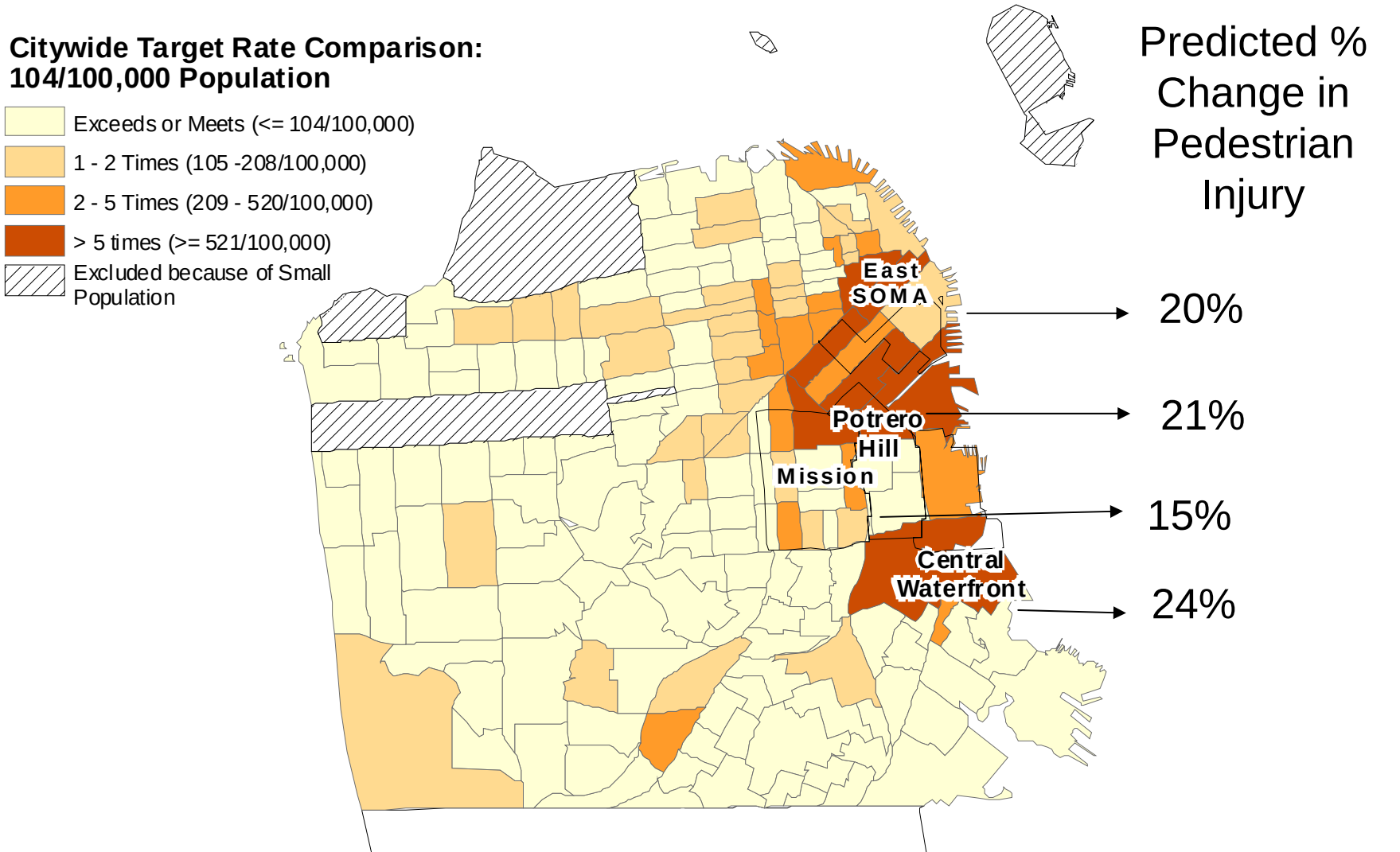
An area-level OLS regression model of Pedestrian-Motor Vehicle Injury Collisions applied to forecasting changes of land use and transportation plans and policies

Significant independent variables in the model:

1. Traffic volume
2. Arterial streets (%, without Muni transit)
3. Land area (square miles)
4. Car ownership (%, access by housing unit)
5. Commuting via walking or public transit (%, pop.)
6. Number of residents

Pedestrian-Vehicle Collision Model

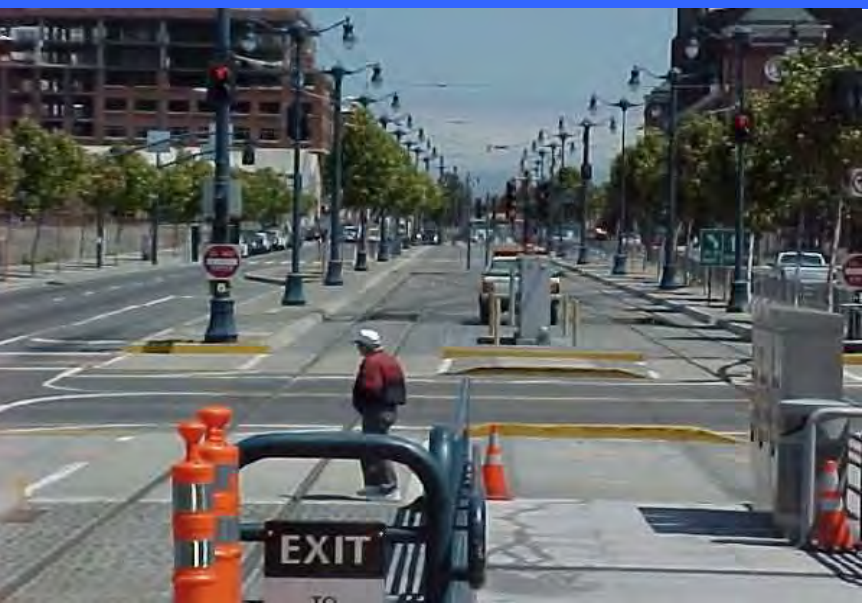
Predicted Increases in Injury Collision Rates Resulting from Eastern Neighborhoods Rezoning



Environmental-Level Health Indicators Applications to Transportation Systems

- Measurable environmental-level metrics of community health
- Many existing metrics
- One metric often linked to multiple health objectives (e.g., VMT)
- Useful in identifying infrastructure needs and environmental constraints
- Measurable outcomes facilitate tracking progress towards health goals

Pedestrian Environmental Quality Index

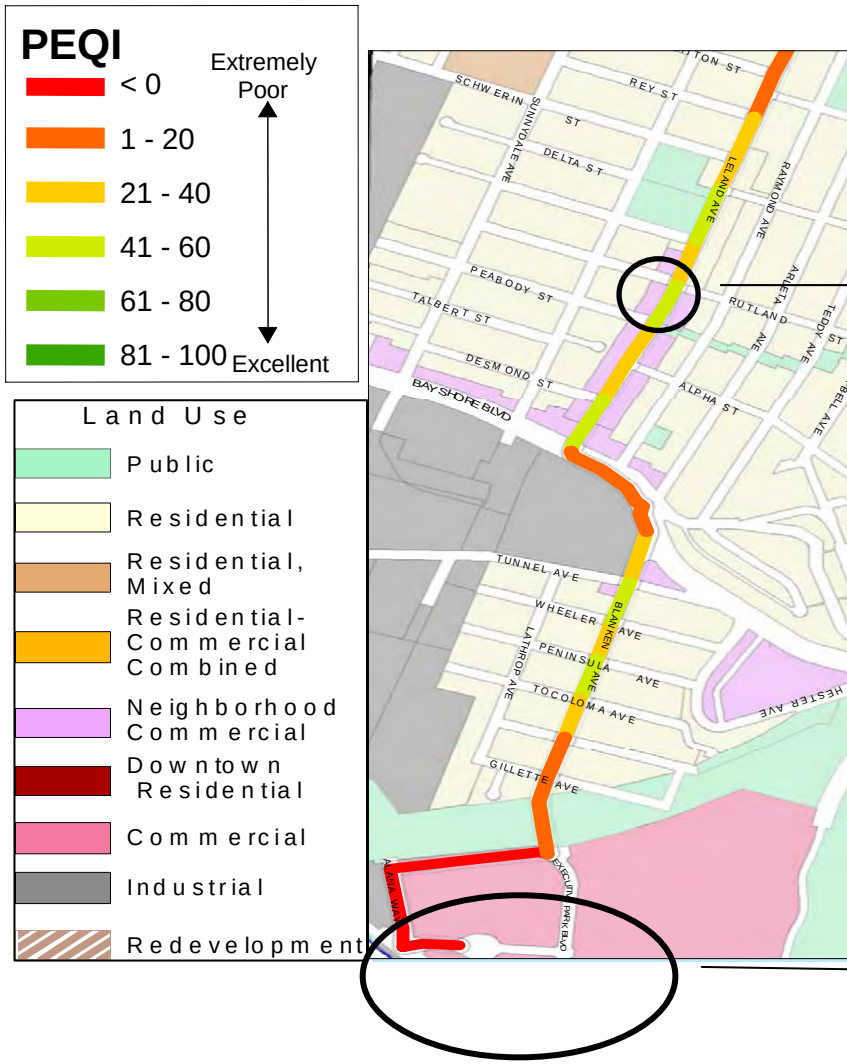


A weighted summary scale of street and intersection environmental variables with influence on walking behavior

Index variables are organized and aggregated under 5 domains

- Traffic
- Street Design
- Land Use
- Intersection Safety
- Perceived Safety

Pedestrian Environmental Quality Index



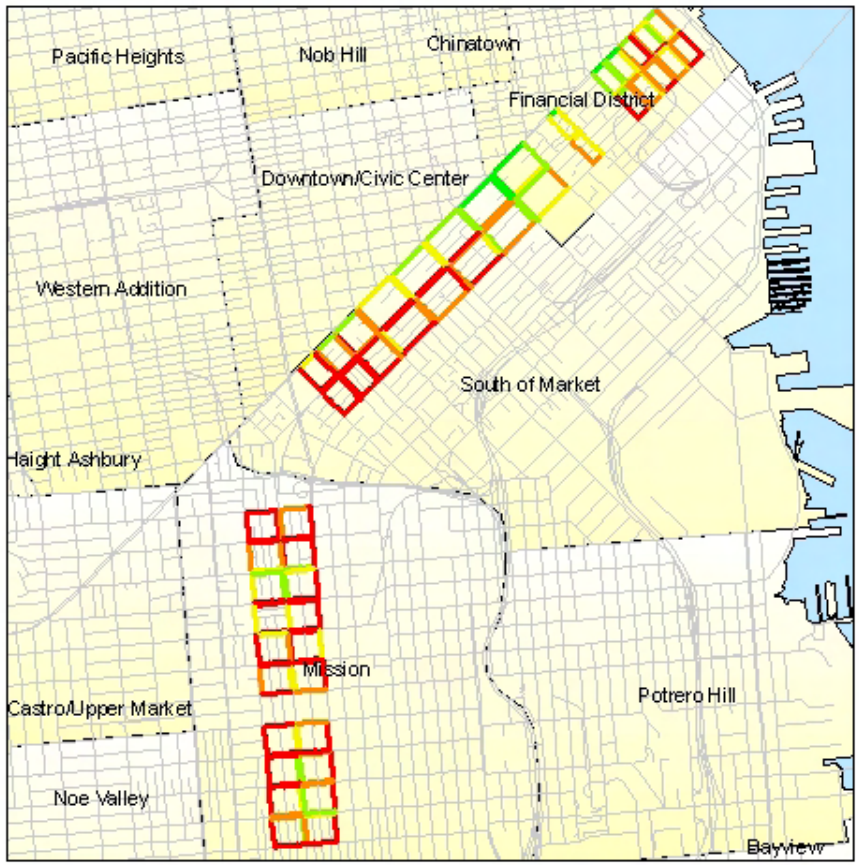
What does this show us?

Basic Pedestrian Conditions Exists.

Pedestrian Environment is unsuitable.

Tools and Metrics Under Development
Pedestrian Flow Model

- Pedestrian Flow is an metric that reflects, transport behaviors, pedestrian environments, and community vitality
- Helps to focus planning on pedestrian needs
- Can also supports retail planning



Quantitative HIA Tools Challenges!

- HIA is emerging science—early efforts and criticisms inform research needs!
- The best predictive forecasts are never certain!
- Application to real world policy challenges established bureaucracies and interests!

Web Resources for HIA Tools

SF Department of Public Health

- www.sfdph.org/phes/

UC Berkeley HIA Course

- http://ehs.sph.berkeley.edu/hia/

Healthy Development Measurement Tool

- www.TheHDMT.org

Human Impact Partners

- http://www.humanimpact.org/